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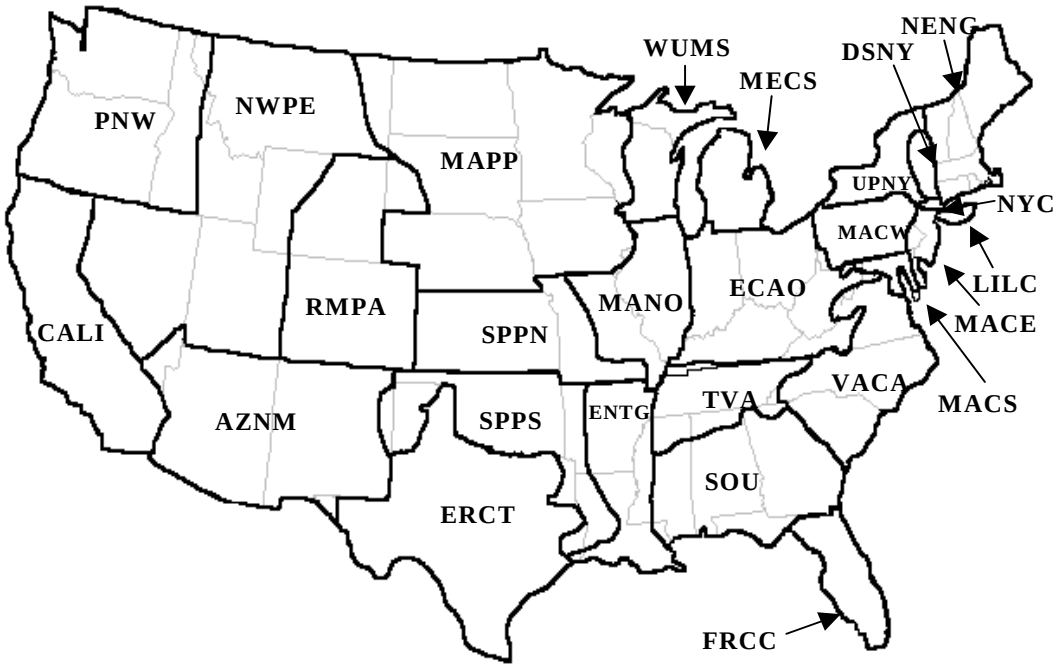
Standalone Documentation for EPA Base Case 2004 (V.2.1.9) Using the Integrated Planning Model



Cover: In the report title EPA Base Case 2004 (v.2.1.9) refers to the update of EPA's application of the Integrated Planning Model that was designed, developed and tested for use in analyzing policy scenarios starting in 2004. The EPA base case and associated policy cases are used to project the impact of environmental policies on the electric power sector in the 48 contiguous states and the District of Columbia. The map appearing on the cover shows the 26 model regions used to characterize the operation of the U.S. electric power system in EPA Base Case 2004 and associated policy cases. IPM was developed by ICF Resources, Inc and is used in support of its public and private sector clients. IPM® is a registered trademark of ICF Resources, Inc.

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1 Introduction

This document describes the nature, structure, and capabilities of the Integrated Planning Model (IPM) and the assumptions underlying the base case (designated EPA Base Case 2004, v.2.1.9) that was developed for the U.S. Environmental Protection Agency (EPA) by ICF Consulting, Inc.[1] IPM is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. It provides forecasts of least cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. IPM can be used to evaluate the cost and emissions impacts of proposed policies to limit emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_X) , carbon dioxide (CO_2), and mercury (Hg) from the electric power sector.

EPA Base Case 2004 serves as the starting point against which policy scenarios are compared. It is a projection of electricity sector activity that takes into account only those Federal and state air emission laws and regulations whose provisions were either in effect or enacted and clearly delineated at the time the base case was finalized in August 2004. (Chapter 3 includes a detailed discussion of the environmental regulations covered in EPA Base Case 2004.) Regulations mandated under the Clean Air Act Amendments of 1990 (CAAA), but whose provisions have not yet been finalized, were not included in the base case. These include.

- *Ozone and Particulate Matter (PM) Standards:* EPA Base Case 2004 predates and so does not include the provisions of the Clean Air Interstate Rule (CAIR), the primary Federal regulatory measure for achieving the National Ambient Air Quality Standards (NAAQS) for ozone (8-hour standard of 0.08 ppm) and fine particles (24-hour average of 65 $\mu g/m^3$ or less and annual mean of 15 $\mu g/m^3$ for particles of diameter 2.5 micrometers or less, i.e., PM 2.5). EPA Base Case 2004 was used as to evaluate policy alternatives which ultimately resulted in the CAIR. The final CAIR was issued on March 10, 2005. EPA Base Case 2004 includes ozone and particulate matter standards to the extent that some of the state regulations included in EPA Base Case 2004 contain measures to bring non-attainment areas into attainment. A summary of these state regulations can be found in section Appendix 3-2 below. Apart from these state regulations, individual permits issued by states in response to ozone and PM standards are not captured in the base case.

- *Mercury Regulations on Electric Steam Generating Units:* EPA Base Case 2004 predates both the Clean Air Mercury Rule (CAMR), which was issued by EPA on March 15, 2005 and the "Maximum Achievable Control Technology" (MACT) standards, which were scheduled to be promulgated by December 15, 2004, but, pending litigation, have been superceded by the CAMR. Consequently, this base case does not include any Federal regulatory measures for mercury control. The only mercury emission limits captured in EPA Base Case 2004 are those included in the state regulations summarized below in Appendix 3-2.

- *Regional Haze:* On July 1, 1999, EPA issued Regional Haze Regulations to meet the national goal for visibility established in Section 169A of the CAAA, which calls for "prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas [156 national parks and wilderness areas], which impairment results from manmade air pollution." The regulations require states to submit revised State Implementation Plans (SIPs) that include (1)

[1] In October 2004 documentation for EPA Base Case 2004 was issued under the title *Documentation Summary for EPA Base Case 2004 (v.2.1.9) Using the Integrated Planning Model* (EPA 430/R-04-008) This report consisted of 9 pages of summary text and a series of exhibits. It focused only on elements of the 2004 base case that had changed since the previous released EPA base case. Readers were referred to documentation for the two previous base cases for elements that had not changed. The current documentation report combines into one standalone volume the documentation for EPA Base Case 2004, eliminating the need to refer to three separate volumes for a complete picture of all the modeling assumptions.

goals for improving visibility in Class I areas on the 20% worst days and allowing no degradation on the 20% best days and (2) assessments and plans for achieving Best Available Retrofit Technology (BART) emission targets for sources placed in operation between 1962-1977. Since the revised SIPs are due between 2004-2006 for areas designated as "attainment" and "unclassified" and between 2006-2008 for "nonattainment" areas, they are not represented in EPA Base Case 2004. However, as seen in Appendix 3-2, the base case includes the sulfur dioxide emission cap (198,900 tons for all affected fossil fired generating units larger than 25 MW), adopted by the Western Regional Air Partnership states of Arizona, New Mexico, Oregon, Utah, and Wyoming in response to Section 309 of the federal Regional Haze Rule.

In effect, EPA Base Case 2004 offers a snapshot projection of the electric sector assuming that the only future environmental regulations are those whose provisions were definitively known at the time that the base case assumptions were finalized. While not an accurate reflection of what will actually occur, this simplifying assumption ensures that the base case is policy neutral with respect to prospective, future environmental policies.

Table 1-1 lists the types of plants included in the EPA Base Case 2004. Table 1-2 lists the emission control technologies available for meeting emission limits in EPA Base Case 2004.

Table 1.1. Plant Types in EPA Base Case 2004

Fossil Fuel Fired	**Renewables and Non-Conventional Technologies**
Coal steam Oil/gas steam Combustion turbine Combined-cycle combustion turbine Integrated gasification combined-cycle (IGCC) coal Cogeneration units Repowered units	Hydropower Pumped storage Biomass IGCC Wind Fuel cells Solar photovoltaics Solar thermal Geothermal Landfill gas Other[1]
Non-Fossil Fuel Fired	
Nuclear	

[1]Includes fossil and non-fossil waste plants.

Table 1.2. Emission Control Technologies in EPA Base Case 2004

Sulfur Dioxide (SO_2)	Nitrogen Oxides (NO_x)
Limestone Forced Oxidation (LSFO) Lime Spray Dryer (LSD) Magnesium Enhanced Lime (MEL)	Combustion controls Selective catalytic reduction (SCR) Selective non-catalytic reduction (SNCR)
Mercury (Hg)	
Combinations of SO_2, NO_x, and particulate control technologies Activated carbon injection[3]	

Notes
1. Fuel switching between coal types and to natural gas is also a compliance option for reducing emissions in EPA Base Case 2004.
2. Documentation for previous EPA base cases had included combustion optimization and biomass cofiring as two additional emission control options that are not routinely incorporated in a base case but are available for use in policy cases where they are likely to represent economically viable options for meeting emission limits being analyzed in the particular policy case. Previous assumptions for these two control options are under review and are likely to be revised and updated before being used in policy case modeling. Consequently, they are not listed in Table 1.2 among the control technologies available in EPA Base Case 2004.

Figure 1.1 provides a schematic of the components of the modeling and data structure used for EPA Base Case 2004. This report devotes a separate chapter to key components shown in Figure 1.1. Chapter 2 provides an overview of IPM's modeling framework (sometimes referred to as the "IPM Engine"), highlighting the mathematical structure, notable features of the model, programming elements, and model inputs and outputs. The remaining six chapters are devoted to different aspects of EPA Base Case 2004. Chapter 3 covers the power system operating characteristics captured in EPA Base Case 2004. Chapter 4 explores the characterization of electric generation resources. Chapter 5 focuses on assumptions regarding emission control technologies. Chapter 6 describes certain set-up rules and parameters employed in EPA Base Case 2004. Chapter 7 summarizes the base case financial assumptions. Chapter 8 presents the assumptions regarding the cost and supply of fuels and emission factors associated with different fuels.

Figure 1.1 Modeling and Data Structure for EPA Base Case 2004, v.2.1.9